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## Co-creating FabLab La Campana: Empowering a marginalised community in the North of Mexico

Lotz, Nicole <sup>\*a</sup>; Thomas, Briony; Fernández Cárdenas, Juan Manuel <sup>c</sup>; Reynaga Peña, Cristina <sup>c</sup>; Díaz de León Lastras, Alejandra <sup>c</sup>; Cortes Capetillo, Azael <sup>c</sup>; González Nieto, Noe <sup>c</sup>; Santamaría-Cid de León, David <sup>c</sup>; López, Fabio <sup>d</sup>; Machado, Rafa <sup>d</sup>; Hayhoe, Simon <sup>e</sup>

<sup>a</sup> The Open University, Milton Keynes, UK

<sup>b</sup> University of Leeds, Leeds, UK

<sup>c</sup> Tecnológico de Monterrey, Monterrey, México

<sup>d</sup> InSitu Foundation, Columbia and México

<sup>e</sup> University of Bath, Bath, UK

\* Nicole.Lotz@open.ac.uk

FabLabs are a celebrated approach to formal and informal learning through making with digital fabrication tools. This paper discusses the co-creation of a FabLab with a marginalised community in Monterrey, Mexico. One of the main challenges in establishing these Makerspaces is in sustaining the activities and community engagement on an ongoing basis. In responding to this challenge, this process focused on the empowerment of community members to make the changes they desire, either for themselves or their community. Beyond skills for making and playful engagement in STEAM learning, makerspaces also facilitate the building of networks and partnerships, and the development of social competencies and soft skills, that are often overlooked in the process of empowerment and social mobility. Primary insights from the co-creation process of the La Campana FabLab are reported here. A Mexican higher education institution with a strong social responsibility agenda facilitated the process, securing funds and connecting project partners, locally and globally. Framing the co-creation of the FabLab with the partners was and is an ongoing process. Key factors included the donation of a safe space and tools for the community to host and run the FabLab. Establishing the role of the FabLab in the community from the participants' point-of-view and committing to regular ongoing educational dialogue was important in forming an equitable partnership between institutions and community. Beyond the physical space, equipment and educational activities, a community architecture intervention demonstrated the large-scale impact digital fabrication could have in creating spaces shaped by and for the community.

**Keywords:** *FabLab, makerspace, STEAM education, equity, empowerment*

## **1 Introduction**

The skill of making is in all of us. It might be hidden or dormant and need activation in some, or it might be seen as an undesirable activity, or a necessity to simply 'get by' in others. Makerspaces and FabLabs promise to reactivate and reframe this core human skill by linking it to new technologies of digital fabrication and a narrative around innovation and renewed sense-making. But does this promise hold for everyone? Scholars argue that FabLabs or Makerspaces, even in developing or middle income countries, still only serve those with 'time, skills, and money to access these spaces' (Woodson, Alcantara, & do Nascimento, 2019). However, the promise of other non-formal educational spaces for developing STEAM (Science, Technology, Engineering, Art and Mathematics) skills have been documented as a successful in cases of marginalised conditions, including Mexico (Fernández-Limón, Fernández-Cárdenas, & Gómez Galindo, 2018; Montgomery & Fernández-Cárdenas, 2018).

Making something is the first step in exploring what one is capable of, i.e. producing something that makes a small change, improves a situation, addresses a personal problem, expresses something or is simply joyful and (aesthetically) pleasing. But how can this seedling take roots in communities that are historically excluded from the learning and development opportunities that these spaces offer? Many scholars agree that opening the doors to FabLabs and Makerspaces alone does not guarantee inclusion. The design and implementation of a FabLab that aims at inclusion needs to utilise a co-design approach from the start (Barton & Tan, 2018; Vossoughi, Hooper, & Escudé, 2016).

This paper reports on the co-creation of a FabLab in, with and for the marginalised community La Campana-Altamira in Monterrey, Mexico. Literature relating to FabLabs, Makerspaces and empowering marginalised communities through making is discussed before the co-design methodology applied in this project is introduced. The co-design process, emerging themes, and the establishment of FabLab La Campana, including on-going work, is subsequently presented and discussed.

## **2 Background**

### **2.1 FabLabs and Makerspaces**

The community maker and education space presented in this paper is connected to the FabLab network and is hence termed a FabLab, but the terms FabLab or Makerspace are often used synonymously. Literature from both strands is reviewed here. FabLabs and Makerspaces overlap in many of the values and principles they adhere to in making, collaboration, learning and sharing. One major difference is that FabLabs are often situated in higher education settings while Makerspaces more often exist in school or community settings. Both use digital fabrication tools to promote STEAM and design learning through creative hands-on making and experimentation (Martin, 2015).

Making not only improves individual wellbeing but also promotes community wellbeing (Yair, 2011). Makers are in a state of focused immersion when ideas are given a physical form and a state of pleasure when the maker discovers 'how something works' (Martin, 2015). Beyond this, professional and communication skills are also developed during the activity of making meaningful objects. The practice not only lifts the mood of individuals but also gives people the opportunity to bond and form relationships (Taylor, Hurley, & Connolly, 2016). The process of making instils feelings of confidence and engagement. It develops a can-do

attitude, promotes self-development and leadership. The ability of an individual to see the impact of making on themselves and on a small community, empowers makers to activate change beyond the immediate maker community, for example in adopting sustainable practices (Charter & Keiller, 2016; Kohtala, 2017), or create links into local policy making (Lindtner & Lin, 2017; Zamenopoulos et al., 2016). Making has been linked to local activism (Garber, 2013) and due to its global reach it has captured governments' attention and their support (Rainwater et al., 2016).

FabLabs and Makerspaces have gained in numbers across the world. They form global networks of individually run spaces. FabLabs encourage open innovation processes that help communities to become more sustainable (Ajuntament de Barcelona, 2014; Fleischmann, Hielscher, & Merritt, 2016; Kankanhalli, Zuiderwijk, & Tayi, 2017) or even self-sufficient (Fab City Foundation, 2018). There is huge variety in existing FabLabs and Makerspaces and they face many challenges relating to their viability and sustainability. Some Makerspaces cease to operate due to being overcome by day-to-day concerns. Prendeville, Hartung, Brass, Purvis, & Hall (2017) argue that building local connections and the nurturing of individual, as well as community capacities, is essential to enable a circular Makerspace economy. For example, the Fab Athenaeums in Barcelona (Spain), is a public FabLab created by the City Council where the FabLab acts as an intermediary between public and private sectors (Gascó, 2017; Kankanhalli et al., 2017). It aims to bring digital manufacturing to its citizens and support projects with a social return. Thus, through open innovation, citizen collaboration and debates across sectors, Fab Athenaeums promotes social transformation (Ajuntament de Barcelona, 2014). Similarly, the Makerspace Media Prado Lab in Madrid offers its users the opportunity to prototype artefacts as solutions for community problems, particularly with respect to innovative uses of public space (Estalella Fernández, Rocha, & Lafuente, 2013). In Mexico, the first public FabLab was created in Mexico City in February 2018, called 'Fábrica de Tacubaya' (Silva, 2018). It seeks to promote digital culture and to put contemporary technologies at the service of the imagination and the community (CDMX, 2018).

Calabrese Barton & Tan (2018) contend that even though the maker movement is built on an empowering vision, the potential for exclusion to this promise, especially in marginalised communities, should not be overlooked. A review of the citation index of research into Makerspaces and FabLabs, clearly shows that this research centres in the West (Chen & Wu, 2017), although the networks stretch across the globe. Similarly, some scholars criticise the global maker movements for strengthening a rhetoric around expensive gadgets/tools and commercial activity being accessed predominantly by the Western educated middle-classes (Vossoughi et al., 2016). In testing this argument, this paper seeks to address: How can a FabLab empower marginalised communities?

## **2.2 Empowering marginalised communities through making**

Our definition of marginalised communities relates to those groups of lower socioeconomic status and disadvantaged conditions, who, in particular contexts, are at the fringes of society and tend to benefit less from education and its related services. Formal STEAM education is known to have limited reach to marginalised populations, but growing evidence suggests that the use of informal spaces as sites for alternative educational experiences should be explored more in this context (Montgomery & Fernández-Cárdenas, 2018; Rogoff, Callanan, Gutiérrez, & Erickson, 2016).



Engaging in hands-on making builds up professional and cognitive skills and, more crucially, confidence in one's own abilities. A key ingredient in this empowerment process is the critical engagement with, and the understanding of, what is made and how it is made. Linking making to STEAM education has been shown to create more insightful and deeper learning than making on its own (Barton & Tan, 2018; Vossoughi et al., 2016). Although STEAM education has been acknowledged to play a role in professional development, employment and entrepreneurial opportunities, several authors emphasise that the marketisation of things made or practical skills gained through making should not be the means-end (Craft, 2013; Montgomery & Fernández-Cárdenas, 2018).

In the same way that makers transform materials, the processes of making transforms the maker. Making something empowers the maker in decision-making and change-making for themselves. This seedling of empowerment can be nourished and grown into something larger, taking the idea of active engagement beyond an object being made, to situations being changed. Craft (2013) calls for humanising creativity in which educators and students co-create alternative, enabling futures. Recursively, equitable partnerships also appear in the literature as key practices for empowerment. For example, Jones and Hussain ((2010) believe that in order to empower a marginalised community in the long-term, a participatory engagement approach with core community and independent partners is necessary (Watermeyer & Montgomery, 2018). Research in participatory practices concurs that there are as many approaches to it as there are projects (Saad-Sulonen, Eriksson, Halskov, Karasti, & Vines, 2018), so which participatory approach would work in engaging a marginalised community to co-create a FabLab?

Strengthening equitable partnerships became a core-principle in the ongoing co-creation of a FabLab in a marginalised community in Monterrey, Mexico, with the aim to empower the community through STEAM-rich learning and making. An outline and discussion of the strategies and approaches that underpin this co-creation process are reported below.

### **3 Methodology**

#### **3.1 Setting**

Monterrey is a relatively prosperous and diverse city in the state of Nuevo León in the north of Mexico. The main research sites were Tecnológico de Monterrey and its neighbouring La Campana-Altamira community, which is a Priority Attention Area with high rates of poverty and social exclusion.

#### **3.2 Co-design process**

A long term, participatory community-design approach (Saad-Sulonen et al., 2018) was used to co-design and co-create a FabLab and associated making activities with members of the La Campana-Altamira community in Monterrey. The British Council in Mexico funded two projects associated with this research, both of which were led by academics from Tecnológico de Monterrey (a multi-campus private University based in Monterrey, Mexico).

In February 2018, the initial scoping workshop at Tecnológico de Monterrey involved 28 college students, 83 in-service elementary and middle school teachers (six of whom had positions at local government and NGOs), and 10 academics from Mexico and the UK. This experience brought practitioners, researchers, students, and community members together in the development of ideas for social innovation. The workshop addressed question around

the complex problems of marginalisation based on socio-economic status, disability or race and ethnicity that are faced in their communities. A design thinking methodology was used to frame problems and prototype solutions to address these problems. Based on the positive feedback and impact of this initial workshop, follow-up funding was gained to implement one solution.

Then, from January 2019, a series of workshops and events involved a further 70 students from Tecnológico de Monterrey, 19 academics and professional staff from higher education institutions in Mexico and three academics from the UK. A further two participants from the Insitu Foundation (Insitu, 2019) and 18 members of public authorities were also involved. The FabLab co-creation process also brought together 50 students from the CBTis 99 high school, 20 high school teachers, 30 primary school children, and 50 members of the La Campana-Altamira neighbourhood. Additionally, the FablatKids.org network manager for Mexico (FabLatKids.org, 2018) maintains weekly workshops with approximately 20 children attending each session.

A co-design approach was taken in the second workshop series in which partners and participants engaged at stages throughout the process. So far, the co-design process has been running for 18 weeks. An initial preparation stage involved community leaders and academics in planning and preparing the workshops (four weeks). At the secondary community scoping stage, academics and members of Insitu Foundation interacted with a wider group of community participants through walks, interviews, workshops and focus groups (four weeks). The core stage was the community co-creation, in which the full range of participants actively co-created the FabLab. During this stage participants set up the room and the equipment, designed and conducted making activities, and negotiated the partnerships, roles and responsibilities of participants and partners (two weeks). The Insitu Foundation used a well-tested digital fabrication and concrete casting methodology for co-creating community design interventions during this stage. During the final stage, which at the time of writing is the past eight weeks, weekly maker events held by the FablatKids.org Mexico network have been exploring the scope of the FabLab with a variety of activities. This co-implementation stage will last for approximately one year, during which new funding for further equipment, activities and research will be sought.

### **3.3 Data collection and analysis**

Qualitative data from design workshops, interviews, focus groups and community walks and mapping exercises were collected throughout the process. Notes, recordings and images were analysed chronologically and thematically and are presented as a case study in the subsequent sections.

## **4 The case of FabLab La Campana in Mexico**

### **4.1 Growing the idea**

In 2018, the project “Reducing marginalization and promoting inclusive education with the mediation of digital technology” produced 17 social innovation proposals for intervening in the impoverished district Campana-Altamira, Monterrey and in other educational settings elsewhere in Mexico. One of these proposals was the installation of a FabLab in the Campana-Altamira district in order to empower citizens to manufacture goods using 3D printers, laser cutting machines, and other digital tools (Figure 1). The initial idea was that

products could be sold and allow the creation of a different local economy and a better income for participants.



*Figure 1 Prototype for La Campana (The Bell) FabLab in 2018*

Building on a unique partnership between higher education and secondary education institutions as well as the local community and maker networks, this idea was developed into a proposal for a follow-up project and funded in 2019. The aims of the project were to:

1. Co-design and implement a FabLab in a marginalised district in Monterrey, Mexico.
2. Develop methodologies for engagement and learning through making for higher education students and high school students.
3. Develop strategies for improving social mobility of disadvantaged students and community members, to facilitate their access to better jobs in a knowledge economy afforded by digital technology.
4. Connect with an international network of FabLabs to improve the quality of STEAM education for marginalised groups.

## 4.2 Framing co-creation

A simple framework for co-creation of the FabLab was developed and refined with the Campana-Altamira community in a series of diagnostic workshops. The framework consisted of 4 pillars: technical making, creative making, sharing/communication and management.

In a preliminary workshop, the community's desires and ideas around the questions 'What do you make?' and 'What would you make?' were investigated and their contributions were categorised. Technical and creative making, and the sharing or selling of objects made were identified by the participants as key objectives for their engagement in the co-creation process. This response was tested with the community in a follow-up making workshop incorporating all these aspects, which asked participants to create a simple light-object from found materials and share a story around this object (Figure 2).



*Figure 2 Workshop creating light objects with light diodes, batteries and found materials*

Finally, participants were asked to rate their experience as positive (green dots) or not so pleasant (red dots) (Figure 3). The results were surprising and did not entirely correlate to the key objectives identified by participants during the preliminary workshop. Technical and creative making was seen very positively, but the communication of what had been made, the sharing of ideas and teamwork were only seen as desirable activities by half of the participants.

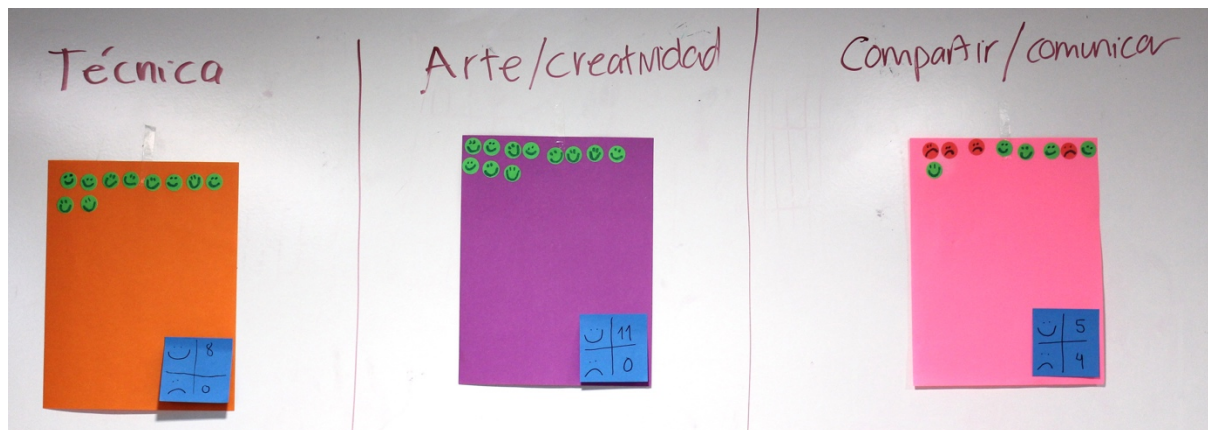


Figure 3 Participants' perception of Fab Lab core co-creation activities

The management of the Makerspace was added as a fourth pillar to the framework and collaboratively developed with the head teacher, subject teachers and students of the high school. A notable impact of these ongoing co-creation events was the provision of a dedicated space for the FabLab at CBTis 99, which had not been offered in the initial scoping contacts with the high school.

#### 4.3 Engaging in playful and meaningful making at all levels

This co-creation process involved a diverse range of participants and partners. The activities and roles for academics, PhD students, professional university staff, undergraduate students from various disciplines (such as business, social sciences and engineering), plus the involvement of high school students, their teachers, and the wider Campana-Altamira community, families and social workers, as well as primary school children, needed to be meaningful and not onerous.

The Tec21 educational model (Tecnológico de Monterrey, 2019) requires undergraduate students to carry out social engagement activities, which count towards their qualification. This model promotes development of abilities to solve real-world challenges, which is considered as a meaningful activity by the university students. Students registered on the project formed teams around particular themes for the co-design process. These work-packages were 1. STEAM Education, 2. Digital Fabrication, 3. Research, 4. Community Co-creation, 5. Sustainability, 6. Communication and Marketing.

Students joined a team for the two weeks running up to the FabLab inauguration, with academics and PhD students mentoring each team. The teams carried out focused activities, which in many cases overlapped, so regular team updates were integral to the process. Mentors gave talks and workshops to introduce objectives and possible activities in each area. A group of up to 22 high school students, three subject teachers and several community members also participated in the talks, seminars and workshops leading up to the opening of the FabLab, despite being officially on term break. Their motivation was to learn how to work with new technologies and materials, train to be able to use the facility and to be able to teach others to use the FabLab resources.

The Education team planned and facilitated a series of engaging and fun making activities for the opening of the Makerspace and also for weekly workshops to attract different age groups (Figure 4). The Communication team recorded events and produced promotional materials for social media to invite further community involvement with the FabLab. The



Research team evaluated the expectations of participants and the impact of the maker events. The Community Co-creation team talked to participants and partners throughout the process and developed pathways for active participation. The Sustainability team investigated different business and social innovation models, and the Digital Fabrication team produced the Maker Cart, FabLab furniture and games as well as the outdoor community installation.



*Figure 4 Fun inauguration activities for all ages*

#### **4.4 Creating a safe space**

When Mexico's Drug War was declared, the Campana-Altamira community, like many other low-income communities, became the centre stage of terrible open conflict and violence (Durin, 2019). The community members retreated and became isolated. With the peak of violence in 2012, a new policy of de-escalation of open Cartel and Government conflict led to a calming of the situation. Now, slowly, community members are seeking to actively remodel and rebuild their community (for example, see Colectivo-Tomate, 2019), but strangers to the community are still seen with suspicion. During an initial walk through the community, members reacted to our request to take a photograph to record a creative use of public space (Figure 5) with: "Why do you want to take a picture of my son? Are you kidnappers?" This was not meant as a joke.



*Figure 5 Youth is 'performing' a haircut in a public market, the setup of which is reminiscent of a stage with bystanders and waiting customers as audience*

One of the most important activities in co-developing FabLab La Campana was the negotiation of a safe space to host it, to which the whole neighbourhood would have access. CBTis 99, a high school in the centre of the neighbourhood emerged as a key partner. Access to this space was negotiated between the host (CBTis 99), workshop facilitators (Tecnológico de Monterrey and FablatKids.org Mexico) and users of the space (CBTis 99 students and La Campana-Altamira). The negotiation of a suitable space in the high school resulted in the donation of a classroom that was transformed into a permanent Makerspace (Figure 6). A 3D printer was purchased and 10 Computers were donated by Tecnológico de Monterrey. The 3D printer and other maker tools were provided in a mobile Maker Cart, which was constructed by the Digital Fabrication team. Maker Carts are often used in educational settings (e.g. Peppler, 2013). Due to the flexibility of the Maker cart, which while mobile can also be secured, the equipment can also be used in other community spaces, e.g. the community social room or Sunday Market.





Figure 6 Fab Lab La Campana – a dedicated room in CBTiS 99 high school with Maker cart in the foreground

#### 4.5 Creating transition spaces

Interviews, observations and community mapping activities of the urban and social context of the area have shown 'unsafe spaces' that facilitate anti-social behaviours (e.g. drug crime and violence, mugging, assault and illegal dumping) but also spaces that the community would simply like to use more or in a different way (e.g. a sport playing field that floods easily). Examples of community maps are shown in Figure 7 and a summary of key places for potential interventions are summarised in Figure 8.



Figure 7 Community maps showing desirable and undesirable areas and potential interventions





Figure 8 Summary of community mapping exercises

Key areas for improvement were identified from which a design intervention brief was elaborated. An ideation workshop with university and high school students, and their teachers, generated ideas for the intervention through brainstorming concepts based on geometric forms (Thomas, Capetillo, Diaz de León, Lopez, & Machado, n.d.). Ideas that developed ranged from seating furniture and hanging tools for the Sunday Market, planters, skate park and parkour objects and outdoor games.

The Insitu Foundation was invited to the project to employ a specific methodology. The aim of this work was to show how digital fabrication tools and concrete casting within a FabLab can achieve larger-scale elements for the community. A total of nine designs were translated into 3D models and five of these were cast in concrete. The use of concrete was a requirement in reducing the likelihood of theft. The final designs, shown in Figure 9, were intended to make the public park spaces more inviting and approachable. These pieces of community furniture seek to reclaim the spaces for the community, making them usable, aesthetically pleasing and safer.





Figure 9 Digitally fabricated community urban furniture/public installation

#### 4.6 Sustaining engagement

Many community co-creation projects cease activity once the public funding ends. A key aim throughout this project was to find pathways to sustain the co-creation process and use of the FabLab beyond the funded period. Emotions at the inauguration were flying high and many promises of support were made. But a government official said: *“This is great, but I would like to come back on a Thursday afternoon and like to see how many are using the FabLab then.”*

In collaboration with Tecnológico de Monterrey’s Innovaction Gym and FablatKids.org Mexico, weekly maker events are organised at FabLab La Campana. One event linked-up several Makerspaces via video conferencing in order to present their work to each other (Figure 10). To this moment, the space has been used for high school project work and teaching specialised workshops on 3D modelling and electronics, as well as holding weekend workshops in collaboration with FablatKids. While the workshops during the week are aimed at teenagers, the weekend workshops are attended by a mix of university students, high school students, younger children and teachers, as well as community members.

Access to the space and resources are continuously negotiated. The high school has previously been involved in other positive community development activities, including

starting a school orchestra with the teenagers. Through the students' links into the community, adults also started to join the orchestra. The hope is that this snowball effect will be re-created with the FabLab to engage a wider community in designing and making. Early on, the community conceded that access to the FabLab needed to be managed more closely than it might be the case of other Makerspaces. Activities need to respond to events outside of their control. For example, the first workshop after the inauguration was cancelled because the city issued a security warning for the area. Currently, the lab activities are still managed by Tecnológico de Monterrey, but recently a potential community lab manager has emerged, who is night guard and concierge at CBTis 99. Slowly devolving the management of the lab to the community will make the coordination of access to the space and the facilitation of regular activities easier.

Participants, particularly teachers, were worried about resources to keep the 3D printer running. An idea the community immediately connected to was to produce their own filament. Using digital fabrication tools they could construct a shredder similar to that reported by Haldrup, Hoby, & Padfield (2018). Plastic bottles could be collected and recycled, which would also address the waste issue identified by the community. Much waste is dumped illegally, which deteriorates the value attached to these littered community spaces. A community activist has started guerrilla planting in the areas that are usually illegally littered. Our makers have built on this and installed the community furniture next to these planted areas. Building links with individual active community members with similar values to the makers is key for initial interventions to take hold.

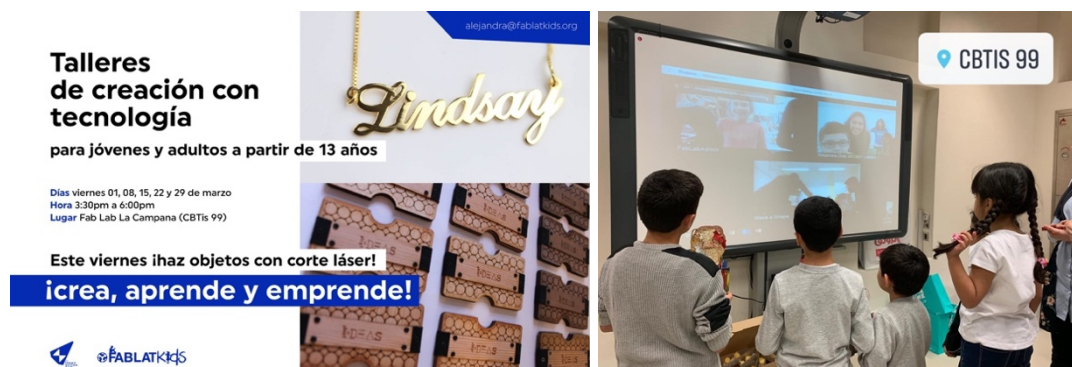


Figure 10 Weekly workshop announcements and a video linked Fablat Kids workshop

Another example of building close and equitable relationships with the community is the close collaboration between a Tecnológico de Monterrey student and a community architect to help to install the community furniture. This has resulted in a continuing internship where students will not only develop professional skills, but also help to strengthen the links between institutions and the community.

## 5 Discussion: equitable making?

FabLabs and their claim regarding empowerment and value creation are not unchallenged (Barton & Tan, 2018; Taylor et al., 2016; Vossoughi et al., 2016). This project addressed many recommendations proposed by Bødker & Kyng (2018) and Vossoughi et al. (2016) in order to realise greater educational equity and sustainable participation in these Makerspaces. This was largely achieved through the application of a co-creation process from the inception of the FabLab. Involving marginalised communities in STEAM learning

should not be built on a deficit ideology (i.e. asking why marginalised communities are less engaged with STEAM learning). Instead, this process started by asking what the community likes doing and what they would like to make, and thus linked their responses to STEAM education and design activities, and the development of the learning activities offered. A co-creation approach made it possible to tap into what are usually scarce resources, such as a safe and dedicated spaces for maker activities or teacher training alongside students' training. A further development in this direction would be the involvement of more community mentors, i.e. elders with particular expertise or traditional skills.

There is a continuum of co-creation approaches ranging from community initiated and expert supported (e.g. designers/academics) to expert initiated with some participation of communities. FabLab La Campana sits somewhere in the middle of this continuum and sways from one to the other side at times. Negotiating ongoing engagement is the goal of a truly equitable partnership. Kraff (2018) has recently argued that participants' circumstances and engagement, particularly in developing contexts, continuously change and hence trajectories for participation should be continuously reflected on. The empowerment of marginalised communities is not a process that can simply be kicked-off and then runs by itself. Taylor et al. (2016) reported that a culprit in the failure of keeping a Makerspace alive is the insufficient demonstration of the impact that the space had on individuals and communities. Makers are often not able to measure and communicate these outcomes. However, this is central in securing or sustaining resource and engagement. During this project in particular, the skills to reflect on actions and simulate potential outcomes was observed to be challenging for many participants. These reflective skills take time and training to develop. Reflection on what was made, and how it was made, at least anchors reflection in something concrete - in action (Schön, 1987). This reflection on action has the potential to develop participant makers' overall reflective capacities.

A challenge related to this lack of reflection on making is the ability to communicate what has been made and what experiences were gained. Although many participants follow and like posts on the FabLab Facebook or Instagram groups, few makers share posts themselves. This could be explained by a perceived unequal power relationship and the right to post on the Social Media platforms of the FabLab, but an earlier workshop clearly demonstrated the fear of failure that these teenagers showed in front of their peers. A high school student said during the storytelling task: *"I don't know what to say about this more than this is a lamp"*.

It has become clear that Makerspaces should not just teach making but also how to share knowledge of what was produced and how it was created to ensure everyone's voice is heard. Although the Social Media platforms were chosen based on a survey of what was used by the community, it might be that commercial Social Media networks are not the right formats for sharing making in this community. The MAZI project argues that commercial platforms and networks render users more and more passive. They have experimented with DIY wireless technology to share relevant knowledge in communities with those already living in physical proximity (Childs & Peachey, 2013).

Tech alone does not support how stories are told. There is a continued need to learn, to reflect on, and to communicate what should be shared and with whom. Bull, Schmidt-Crawford, McKenna, & Cohoon (2017) talked of 'storymaking' as a maker activity, combining coding and storytelling. Often, the youth want to play with tech, while older adults want to share their wisdom. A future making workshop could pair youth and older adults to tinker and

capture stories at the same time. These stories need to be told in a non-exclusive language. For example, processes of iteration, reflection and learning should not be labelled as failure. The 'fail often to succeed earlier' slogan publicised by IDEO will sound very off-putting to some communities. Raina (2018) maintains that in most developing economies, experimentation is viewed by craft-workers as wasteful and risky. Marginalised or impoverished communities may have more negative associations with failure, so that the intended positive meaning of Western mantras such as IDEO's might easily be overlooked.

Connecting formal and informal learning communities needs ongoing dialogue and support (Saad-Sulonen et al., 2018). Some participants benefit by learning more about co-creation processes, while others learn to make or produce locally relevant designs through learning with technology. A different form of STEAM teacher training is made possible through engagement in the FabLab and the strategic partnerships between teachers in the community and educators in the university setting (Montgomery & Fernández-Cárdenas, 2018).

Any activity around the FabLab needs to be designed with multiple purposes in mind in order to be successful. The overlaps between these meaningful activities enable participants to co-design, co-investigate and co-make. The question of 'Making of what (and how and why)?' needs to drive pedagogies that help apply STEAM learning and design knowledge to everyday activities and settings (Fernández-Limón et al., 2018). Creating meaningful dialogues between formal and informal learners has been identified as a key challenge to collaboration (Jowers, Gaved, Elliott-Cirigottis, & Dallison, 2016), and will form the focus of the ongoing activities in the FabLab.

## **6 Conclusions**

Through this project we have sought to respond to the question: 'How can a FabLab empower marginalised communities?' The case of FabLab La Campana in Monterrey, Mexico has shown that the co-design, co-creation and co-implementation of a Makerspace for, and with, this marginalised community has empowered its participants to engage in STEAM learning activities in an informal setting.

The seed of an idea of a FabLab was grown collaboratively. An equitable relationship between higher education institutions, third sector organisations and the marginalised community has been sustained through ongoing dialogue, regular events and frequent reporting of what has been achieved.

Participants co-created a safe space to encourage playful ideation and experimentation. Although situated in a high school, this is an informal learning space that also facilitates participation of vocational learners and makers from the larger community. Bringing making into community-created transition spaces through fabricated design interventions presented the scope of making to the community, which extends beyond the individual gain in skills and knowledge in a FabLab.

A key question is how can these change trajectories, already evident in some individual participants through the FabLab co-creation process, help to create a pathway for empowerment of the larger community? The potential impact of the empowerment of community through makerspaces is the access to informal education and to the high-skilled labour market and opportunities of entrepreneurship, which is usually denied to



underprivileged communities. The reflection on learning through making and the sharing of these experiences are areas that need ongoing investigation and support in order to empower the FabLab users and wider community.

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### **About the Authors:**

**Dr Nicole Lotz:** Nicole is a Senior Lecturer in Design at The Open University, UK. Nicole is interested in design processes across continents, cultures and levels of expertise. Her work aims at understanding and supporting designers to engage, persevere and succeed in challenging situations.

**Dr Briony Thomas:** Briony is a Lecturer in the Institute of Design, Robotics and Optimisation (iDRO) at the University of Leeds. Her research explores the embedding of arts approaches within the sciences and the integration of science within art and design processes.

**Prof Juan Manuel Fernández-Cárdenas:** Juan Manuel is Full Professor of Education at Tecnológico de Monterrey, México. His research interests include the conformation of communities of practice around STEM educational activities. He has published more than 75 refereed research articles, chapters, and books.

**Dr. Cristina G. Reynaga-Peña:** Cristina is a Research Professor of Education at Tecnológico de Monterrey, México. Her research interests include the processes of inclusive science education including teacher professional development. She authored 30 research outputs and holds 24 Mexican patents.

**MArch Alejandra Díaz de León Lastras:** Alejandra is a Prototyping Laboratory Manager and professor at the Institute of Technology and Higher Education of Monterrey. She is also a collaborator in the Global Fab Lab network where she leads the initiative for bringing digital fabrication as a learning tool for children.

**Dr Azael Capetillo:** Azael is a Research Professor of the School of Engineering and Sciences at Tecnológico de Monterrey, Mexico. He is Director of the Innovation GYM with research interest in innovation management, product development and technology-based entrepreneurship.

**Noé Abraham González Nieto:** Noé is a PhD Student at Tecnológico de Monterrey, México. His research interests include the study of the nexus between migration, conflict and education with a futures perspective approach and the use of comparative and international education methodologies.

**David Santamaria:** David is PhD in Education student at Tecnológico de Monterrey in México. His research interests include narrative literature in the construction of civic engagement, integral education and inclusion of marginalized groups in societies.

**Arch. Fabio Lopez:** Fabio is co-founder of the Insitu Foundation. He creates public spaces in non-consolidated urban areas using participatory research, design and implementation, auto-construction processes, digital & fabrication technologies and recycling materials methods.



**Arch. Rafael Machado:** Rafa is from Caracas and professor at the Central University of Venezuela (UCV), his work is centred in urban transgressions and participatory community processes.

**Dr Simon Hayhoe:** Simon is a Reader in the Department of Education and admissions tutor for the MA Education. Simon's current work focuses on the epistemology of disability and ability, with special reference to education, inclusion, technology and the arts."

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